11/4/13
Ohio Air Manganese Study - Approach and Preliminary Results
(adapted from http://www.epa.gov/nheerl/mnstudy/approach.html)

Approach

In August 2009 a manganese health study was conducted by San Francisco State University in Marietta OH (a community near a smelter emitting manganese) and Mount Vernon OH (a community without a large airborne manganese source). The East Liverpool study fieldwork was done in November 2011 and followed a similar protocol so that data from all three communities could be compared.

Researchers randomly selected (when possible)adults in each of the three communities between the ages of 30-75.They collected data from the study participants including a general health questionnaire, blood test, neurological and mood assessments, and neuropsychological tests.

Blood Tests

Researchers analyzed blood for heavy metals including levels of manganese, cadmium, lead and mercury, and of serum ferritin – an indicator of iron stored in the body.

Neurological Assessments, Neuropsychological Tests, and Mood

Researchers used a battery of assessment tools to measure cognitive flexibility (switching categories), information processing, working memory and attention, visual tracking speed, verbal skills, motor dexterity and strength, postural sway and tremors. Each of these test results yield important information about the brain function of study participants that can be used to evaluate the potential impact of manganese exposure.

Air Modeling

An EPA air dispersion model and measurements of manganese air concentrations at several fixed locations estimated the concentration of manganese in air outside the homes of study participants. These estimates, along with the distance from the source and the years of residency were used to calculate an "exposure index" for each resident. This exposure index helped estimate inhalation exposure to airborne manganese.

Preliminary Results

No statistical differences were noted between residents of East Liverpool, Marietta and Mount Vernon communities for:

- General health categories (e.g., number of good, bad health days per month, smoking status, obesity, etc.)
- Amount of manganese consumed in diet (manganese is an essential nutrient and is found in many leafy green vegetables and beans)

- Blood manganese levels – the average blood manganese level in the general population ranges between 4-15 µg/L . The following levels were detected:
    - East Liverpool = 10.32 µg/L
    - Marietta = 9.65 µg/L
    - Mount Vernon = 9.48 µg/L
- Blood lead and serum ferritin levels
- Neurological assessment testing: Activities of Daily Living (the things we normally do to care for ourselves, such as eating, bathing, dressing, grooming, work, etc.) and motor (movement) scores
- Neuropsychological tests: tests of attention and memory tests
- Mood tests: mood disturbance (depression, bipolar disorder, etc.)

Statistical differences were noted between the three communities for:

- Blood: East Liverpool residents had higher average blood cadmium levels than Mount Vernon residents, but they were still within the normal range found in the general population. East Liverpool residents had lower blood mercury levels than Marietta residents.
- Neurological assessment:
    - East Liverpool residents showed slower movement initiation (results in delays in onset of movement) than Mount Vernon residents, but were slightly better than Marietta residents.
    - More hand tremors (involuntary shaking) were observed in East Liverpool residents than Marietta residents.
    - East Liverpool residents had more postural sway/instability (involuntary swaying or instability when standing on both feet) than Marietta and Mount Vernon
- Neuropsychological tests:
    - Scores in all three communities were within normal range, except for divided memory, visual memory, and motor speed.
    - East Liverpool residents had lower scores for immediate memory (daily living) than Marietta
    - East Liverpool residents had lower scores than Marietta and Mount Vernon for word reading, motor speed, motor strength and motor tactile.

Exposure Index

The combined data from East Liverpool and Marietta showed that having a higher exposure index was related to lower neuropsychological and motor performance. Living a shorter distance from a manganese source was also associated with neuropsychological and motor performance. The strongest effects were seen for tremor, motor speed, and motor strength.

from 7/11/13 summary slides:

In July 2013 preliminary results from a USEPA-funded study of exposure to and effects of airborne manganese (Mn) in Ohio adults were presented at East Liverpool OH public meetings. Subtle health effects associated with long term airborne Mn exposure were reported at the East Liverpool meetings; for example, living closer to the Mn source for a longer time (more Mn air exposure) was associated with borderline to mild tremor and slightly lower motor speed and strength. East Liverpool study results are being combined with prior study results from Marietta and Mt. Vernon OH adults for publication in the professional literature. Historic monitored outdoor air Mn concentrations in East Liverpool have been among the highest in the US, but the East Liverpool source most likely responsible (SH Bell) has made substantial operational changes in the past few years that have lowered East Liverpool airborne Mn. Involved state and federal agencies are committed to continuing monitoring and oversight.

- Health study found subtle health effects associated with airborne Mn
- Airborne Mn has been high in East Liverpool
- SH Bell has made substantial changes to its operations
- Airborne Mn lower now than in past due to long term efforts (SH Bell, Ohio agencies, federal agencies)
- US EPA's most recent SH Bell investigation conducted in summer 2013
- State and federal agencies will continue monitoring and oversight